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A New Species of Murre, Genus *Uria*, from the Late Miocene of California (Aves: Alcidae)

Hildegarde Howard

Abstract.—A new species of murre, genus *Uria*, from the late Miocene of California (Aves: Alcidae) by Hildegarde Howard, *Bull. Southern California Acad. Sci.*, 80(1):1–12, 1981. A new species of murre, *Uria brodkorbi*, is represented by impressions of the skull and incomplete skeleton of one individual on two slabs of diatomite from the late Miocene Sisquoc Formation, exposed near Lompoc, California, U.S.A. This is the seventh species of fossil bird to be described from this formation. *Uria brodkorbi* is very similar morphologically to the Recent *Uria aalge* that is common along the California coast today, but differs in being of heavier build and having a shorter beak, a stronger sternum and more massive wings.

Introduction

A previously unrecorded fossil bird specimen from the diatomite deposits of the Sisquoc Formation near Lompoc, California, was recently made available to me for study and description through the generosity of Dr. Pierce Brodkorb, of the University of Florida. The new fossil consists of the impressions of the skull and the anterior elements of the skeleton on two contiguous slabs of diatomite; it represents a new species of murre, family Alcidae.

Six species of marine birds were described from the same late Miocene deposits at Lompoc by Miller (1925). These include three species of the booby-gannet family (Pelecaniformes: Sulidae): *Miosula media, Sula willetti* and *Morus lompocanus*; a shearwater (Procellariiformes: Procellariidae), *Puffinus diatomicus*; a godwit (Charadriiformes: Scolopacidae), *Limosa vanrossemi*; and an auklet (Charadriiformes: Alcidae), *Cerorhinca dubia*, of smaller size than the alcid specimen now at hand and related to the puffins rather than to the murres.

Although the number of fossil bird specimens collected from the Sisquoc Formation has nearly doubled since the time of Miller's report (1925), no additional species have been described from the deposits. The holotypes and many of the referred specimens are in the collections of the Museum of Paleontology at the University of California, Berkeley. The others are in the Natural History Museum of Los Angeles County and the California Academy of Sciences. Most of the approximately 20 avian specimens now known from these deposits are skeletal imprints in diatomite with no bones remaining. One specimen, assigned to *Cerorhinca dubia* (LACM 74068), retains badly fragmented wing bones.

The specimen now at hand is in the collection of Dr. Pierce Brodkorb (PB 7960). It was acquired by Dr. Brodkorb many years ago under a Cooperative Agreement with the Florida State Geological Survey. Dr. Brodkorb was unable to learn particulars regarding the collection of the specimen. The label data read, "Sisquoc Formation, Santa Barbara Co., Cal. Diatomaceous earth quarries in this area. Johns Manville Co."

Photographs of PB7960 viewed in certain lights cause the image of the impressions to be reversed, so that the skeletal elements appear in relief (Figs. 1 and 2). In this aspect the skeleton so closely resembles that of the present-day murres, genus *Uria*, that had the deposit been of Pleistocene age, the specimen might have been identified as the Common Murre, *Uria aalge*, that is found along the California coast today. More detailed study, however, reveals important differences. Therefore, a new species is here described.

Methods and Materials

In order to observe more closely the details of the skeleton of this fossil murre, latex molds were made of the impressions in the diatomite. Two sets of molds were prepared, each made directly from the slabs in an effort to assure maximum accuracy of detail. One set remains with the holotype, the other is in the cast collection of the Natural History Museum of Los Angeles County. Although the skeletal impressions in the diatomite slabs were checked for measurements, the actual study of the specimen was based largely on the latex molds.

Abbreviations.—The following acronyms are used for specimens cited in the text: ANSP, Academy of Natural Sciences, Philadelphia; CSULB, California State University, Long Beach; LACM, Natural History Museum of Los Angeles County; PB, Pierce Brodkorb collection; USNM, National Museum of Natural History, Smithsonian Institution.

Bone terminology follows Howard (1929).

Comparative material.—Recent: Complete skeletons of *Uria aalge californica* (17), *U. a. inornata* (6), *U. lomvia lomvia* (2, one lacking complete skull), *U. l. arra* (10), from the collections of CSULB, LACM and PB. Also disassociated elements of *Uria* spp. from Aleut middens in Amchitka, Alaska (CSULB): 48 humeri, 45 coracoids and 36 carpometacarpi. With the exception of the genus *Alle*, specimens representing all other North American genera of Alcidae were also compared.

Fossil: *Uria antiqua* (Marsh 1870), cast of holotype humerus (ANSP 13357); *Uria affinis* (Marsh 1872), cast of holotype humerus (ANSP 13358); *Australca* cf. *grandis* Brodkorb 1955, proximal and distal ends of humeri (USNM 192758 and 178136) and ulnae (USNM 193326 and 215652, complete coracoid (USNM 215513) and proximal end of carpometacarpus (USNM 215906) from the Lower Pliocene Yorktown Formation, Lee Creek, North Carolina; *Miocepphus* cf. *mcclungi* Wetmore 1940, humerus (USNM 25668) from the Middle Miocene Calvert Formation, Maryland; ?*Uria* sp., proximal end of humerus (LACM 52018) from the late Miocene Monterey Formation, Orange County, California.

Systematics

Class Aves Linnaeus 1758
Order Charadriiformes (Huxley 1867)
Family Alcidae Vigors 1825
Subfamily Alcinae (Vigors 1825)
Genus *Uria* Brisson 1760

In the fossil specimen from Lompoc, as exposed on the diatomite slabs and shown in the latex molds, the following characters shared with *Uria, Alca* and

Pinguinus (genera that Storer (1960) groups together in the tribe Alcini) are observable: sharply ridged temporal fossa of the cranium, carpometacarpus with long process of metacarpal I, and humerus with depressed, ovoid pectoral attachment and with external tuberosity projecting anconad.

The straight beak and well developed wing elements immediately distinguish the fossil specimen from *Pinguinus*. The straight beak also distinguishes the fossil from the genus *Alca*. Other distinctions from *Alca* include the more rounded shaft of the humerus and the less acute bend in the anconal profile of its distal end, and a narrower coracosternal connection. In all of these characters, as well as in the general proportions of the skeleton, the fossil resembles the murres of the genus *Uria*.

Uria brodkorbi new species
Figures 1–4

Holotype.—PB7960, consisting of impressions of skull and anterior portion of skeleton on two slabs of diatomite. Slab PB7960A contains the skull in lateral aspect, and seven cervical vertebrae: slab PB7960B contains the incomplete furcula, sternum, coracoids, scapula, ribs and wing bones.

Plastotypes.—Latex molds made from the holotype PB7960A and PB7960B are stored with the holotype and at LACM.

Formation and age.—Sisquoc Formation, late Miocene, Clarendonian land mammal age.

Locality.—Johns Manville diatomite quarry near Lompoc, California. Collector and date of collection unknown.

Etymology.—The new species is named in honor of Dr. Pierce Brodkorb.

Diagnosis.—Premaxillary symphysis shorter than in *Uria aalge* or *U. lomvia arra*, closer to *U. lomvia lomvia*. Height of mandible at angular greater than in either Recent species of *Uria*. Sternum with broadly curved anterior margin, in contrast to straight contour dorsal to forward thrust of the carinal apex typical of Recent *Uria*; tip of carina more truncated and anterior carinal margin more protruded anteriorly. Coracoid with well developed procoracoid as in Recent *Uria*, but with the tip sharper and more upturned; scapular facet more deeply cup-shaped than in *U. aalge*, and rounder, less oval than in *U. lomvia*; glenoid facet broader than in either Recent species. Humerus with area below head narrowed by flange extending mediad from pectoral attachment below external edge of head, and, internally, by raised area marking medial extent of capital groove; line of M. latissimus dorsi anterioris not paralleling shaft as in Recent species of *Uria*, but slanting palmad from distal edge of pectoral scar along external side of shaft, nearly 20 mm in length. Distal metacarpal symphysis of carpometacarpus with metacarpal III sloping distad rather than forming distinct right angle as in *U. aalge*; closer to *U. lomvia*, but distal margin more raised.

Measurements (in millimeters).—Because of the condition of the specimen, many of the measurements are based on the latex mold, with the skeletal impressions used as a check. At best all measurements are approximate.

Skull: Greatest length 93.6; length of rostrum 53.0; length of premaxillary symphysis 25; greatest height of mandible 12.5.

Sternum: Length from carinal apex to tip of posterior lateral process 122; height from carinal apex to ventral lip of coracoidal sulcus 36.

Fig. 1. *Uria brodkorbi,* holotype in diatomite slabs PB7960A (top) and PB7960B (bottom). Lighting of photograph makes impressions appear in relief. Length from tip of beak to posterior tip of sternum 338 mm.

Fig. 2. *Uria brodkorbi*, holotype slab PB7960B showing impression on left side. Depending on the angle viewed, the skeletal elements appear raised or impressed. Length of complete carpometacarpus 47.5 mm.

Coracoid: Length from foremost (anterior) edge of coracohumeral surface to external tip of sternal facet 42.5; depth of shaft to tip of procoracoid 11.5; breadth of glenoid facet 6.5; length of glenoid facet 8.0; distance from procoracoid to foramen 6.6.

Humerus: Greatest length 90 approx.; breadth of proximal end across external and internal tuberosities 18; proximodistal height of head 7; length of pectoral attachment through external tuberosity 12; greatest breadth of pectoral attachment 4; greatest distance from distal end (externally) to point of contact of ectepicondylar prominence with shaft 12.3; depth of external side of distal end 8.0; depth of shaft above distal end 7.5.

Ulna: Depth of distal end, externally, 8.0.

Radius: Length 66 approx.

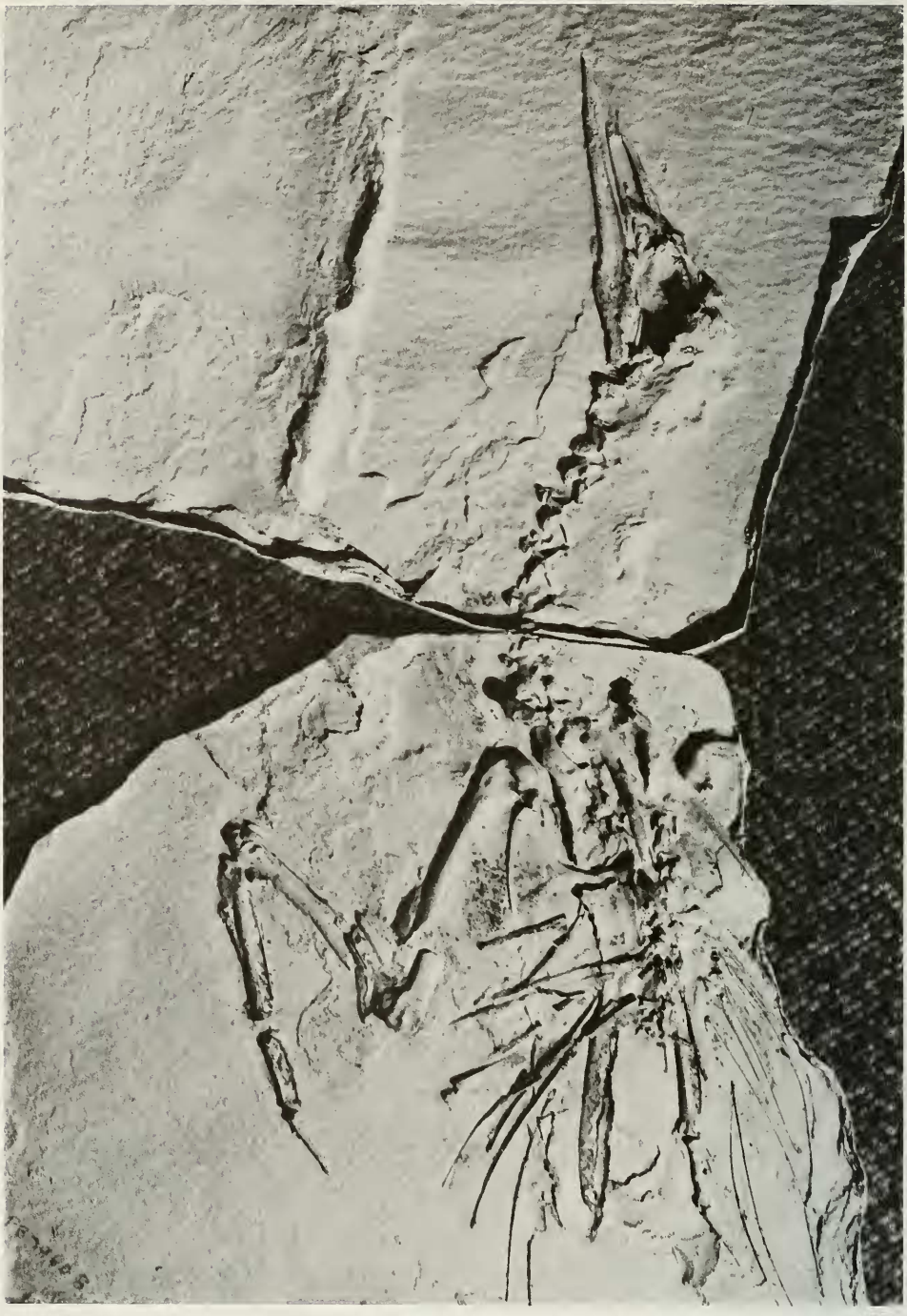

Fig. 3. *Uria brodkorbi,* latex molds of holotype showing left side. Length from tip of beak to posterior tip of sternum 338 mm.

Fig. 4. *Uria brodkorbi,* humerus on latex mold of holotype. Approximately natural size.

Carpometacarpus: Greatest length, externally, 47.5; length of process of metacarpal I, 9.3; depth of distal end from internal tuberosity of metacarpal II through distal metacarpal symphysis, measured on right carpometacarpus, 8.0.

Wing phalanges: Lengths: digit I, phalanx 1, 21.2; digit II, phalanx 1, 20.8; digit II, phalanx 2, 21.5; digit III, phalanx 1, 9.3.

Description.—As exposed on the diatomite slabs and shown in the latex molds, the left side of the skull and sternum and the elements of the left side of the skeleton are best preserved.

Although the cranial part of the skull is incompletely preserved, the rounded posterior contour of the supraoccipital and the narrow, sharply ridged temporal fossa are distinguishable. The latex mold (Fig. 3) defines the extent of the short beak, which more closely resembles that of *Uria l. lomvia* than any of the adult specimens of either *U. l. arra* or *U. aalge* at hand. The mandible depth is even greater than in *U. l. arra* (see Table 1).

The position of the furcula is indicated on holotype slab PB7960B by two holes anterior to the coracoids. Filled with latex in preparing the molds, the poorly defined tips appear, but reveal no dependable characters.

The sternum is damaged posterior to the coracoidal sulcus, and the area of the costal ridges is pushed forward and folded onto the carina so that from this point to the posterior end the dorsal surface is exposed. Because of this damage, the total length as measured on the specimen (and given above) could be as much as 10 mm less than the actual length of the sternum. The anterior contour of the carina shows clearly in lateral view (Fig. 2) as a broad arch, in contrast to the straight contour dorsal to the forward thrust of the apex typical of the Recent species of *Uria*. Further distinctions lie in the more truncated tip and the more forward-protruding flange along the anterior carinal margin. Only one Recent specimen of murre (*U. aalge californica*, LACM 674) has a suggestion of these characters.

The brachial tuberosity is poorly shown on the right coracoid, and is not visible on the left, which is otherwise better preserved. The glenoid facet is relatively broader than in the modern species of *Uria*. The scapular facet is deeper than in *U. aalge,* being closer to *U. lomvia* in this respect, though more rounded, rather than oval. The length of the procoracoid resembles the condition in Recent *Uria,* but the projection is sharper and more upturned than in most of the specimens examined (see Fig. 2). The small foramen is well below the tip of the procoracoid; the size and position of the foramen is variable in the sample of specimens of the Recent species. Although the sternal facet of the coracoid is not exposed, the shape of the coracoidal sulcus of the sternum suggests that the sternal end of the coracoid is long and narrow as in *Uria,* with the facet possibly even more laterally extensive than in the Recent species. This condition is in contrast to that found in the puffins, or even in *Alca,* in which this articular surface is shorter and deeper.

The left scapula is incompletely revealed in ventral view (Fig. 2). Neither the acromion nor the coracoidal articulation is visible, and the shape of the glenoid facet is not clear.

The broken left humerus (Fig. 4) lies with the proximal end presenting an aspect slightly lateral of anconal, while the distal fragment is turned so as to expose more of the external side. The proximal end of this element shows the most notable differences from the Recent species of *Uria.* As observed in the latex mold (Fig. 4), the pectoral attachment is broad, with a distinct flange extending below the head, narrowing the area between the attachment and the median crest; the head appears to be less sharply undercut. A flange of variable extent occurs in a few specimens of both *U. aalge* and *U. lomvia,* but in none is it as strongly developed or as evenly contoured as in the fossil. The line of the anterior latissimus dorsi muscle in *U. brodkorbi* is as long as in Recent *Uria,* but the slope is more markedly palmad and is emphasized by the more rounded anconal aspect of the shaft. Distally, the external tricipital groove is sharply rimmed; the entepicondyle is incomplete and the width of the internal groove is not clear. However, the slight anconal flare toward the distal end, as shown in the latex mold (see Fig. 3) suggests that the internal groove is broader than the external, thus resembling the condition in *Uria.* This contrasts with *Alca* in which the anconal contour of the shaft bends palmad, and the two grooves are of equal size. The tip of the ectepicondylar process is more prominent than in most specimens of Recent *Uria.* There is, however, considerable variation in the Recent series, and a few specimens approach the same prominence, although only one (of maximum size) is as elevated above the distal end, and the ectepicondylar process is less vertically placed with respect to the shaft.

The ulna and radius are crushed proximally, and provide little information other than approximate length of the radius.

The external side of the complete left carpometacarpus, and the internal side of the distal end of the right carpometacarpus are exposed. In overall length, as well as in the length of the process of metacarpal I, the element falls within the size range of *U. l. arra* (see Table 1). The rounded distal contour of metacarpal III (see Fig. 2) is approached in some specimens of *U. lomvia.*

Comparison with previously recorded fossil Alcidae.—Three extinct species of *Uria* have been previously described, each on the basis of the humerus: *Uria*

antiqua (Marsh 1870) from the Lower Pliocene of North Carolina; *U. affinis* (Marsh 1872) from the Pleistocene of Maine; and *U. ausonia* Portis 1887 from the Pliocene of Italy. *U. ausonia* is based only on the distal end of a humerus, which I have not examined.

A cast of the holotype of each of the other two species is available. Both are longer than the humerus in the holotype of *Uria brodkorbi* (*U. antiqua* length 96.2 mm, *U. affinis* length 95.0 mm as given by Marsh (1870 and 1872), and closely approximated on the casts), with greater breadth between the pectoral attachment and the median crest. Both also have the line of M. latissimus dorsi anterioris paralleling the shaft as in Recent species of *Uria,* in contrast to *U. brodkorbi* in which the muscle line slopes palmad. *U. affinis* further resembles Recent *Uria,* distally, in the unequal breadth of the tricipital grooves, the internal being wider, as appears also to be true of *U. brodkorbi.* In *U. antiqua* the grooves are of equal breadth. The humerus of *U. antiqua* resembles that of *U. brodkorbi* in the rounding of the shaft toward the proximal end, although the shaft is heavier and the apex more anconal in position in *U. antiqua.*

There is one previous tentative record (Howard 1978) of *Uria* from the Miocene of California. The record is based on an incomplete proximal end of a humerus (LACM 52018) from locality LACM 6902 in the late Miocene Monterey Formation of Orange County. The specimen is slightly smaller than the humerus of the approximately contemporaneous *U. brodkorbi,* lacks the flange from the pectoral attachment to the head, and is more excavated below the head. It resembles the humerus of *U. brodkorbi,* however, in the rounding of the shaft and the palmad trend of the line of M. latissimus dorsi anterioris.

Two extinct genera are worthy of consideration in comparison with *U. brodkorbi*: *Australca* Brodkorb 1955, genotype *A. grandis* from the Middle Pliocene Bone Valley Formation of Florida; and *Miocepphus* Wetmore 1940, genotype *M. mcclungi* from the Middle Miocene Calvert Formation of Maryland. The holotype of *A. grandis* is a coracoid, with humerus, radius, ulna, carpometacarpus and tibiotarsus referred (Brodkorb 1955). The holotype of *M. mcclungi* is a humerus. This and a subsequently referred humerus (Wetmore 1943) from the type locality are the only recorded specimens of *Miocepphus.*

Through the kindness of Dr. Storrs L. Olson, of the National Museum of Natural History, specimens that he considers referable to *Australca* and *Miocepphus* have been made available (see Comparative Material above). The *Australca* material is similar in size to measurements given for *A. grandis* (Brodkorb 1955), but is not from the type locality. The *Miocepphus* humerus, however, comes from the same formation as the holotype of *M. mcclungi,* though in Zone 13 of the Calvert Formation (the type is from Zone 12). The specimen is intermediate in size between the holotype (Wetmore 1940) and the referred specimen (Wetmore 1943) of *M. mcclungi,* both of which are markedly smaller than the humerus of *U. brodkorbi.* As size is not a generic character, the specimens of both *Australca* and *Miocepphus* are analyzed on the basis of their qualitative characters.

The major distinction of the *Australca* coracoid from that of *U. brodkorbi* lies in the more posterior position of the procoracoid (inset from the median edge of the coracoidal shaft). This character is shown clearly in both the referred specimen at hand and in the illustration of the holotype (Brodkorb 1955:50, fig. 24).

Table 1. Measurements (in mm) of holotype of *Uria brodkorbi* and comparable elements of *U. lomvia* and *U. aalge*.*

Element	*U. brodkorbi*	*U. l. lomvia* (2)		*U. l. arra* (10)			*U. a. inornata* (6)			*U. a. californica* (17)		
		Max.	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.
Skull												
Greatest length	93.6	95.0		108.9	104.7	101.0	107.2	102.2	97.2	110.2	104.6	100.3
Premaxillary symphysis**	25.0	21.7		27.7	25.0	23.3	30.1	28.0	26.2	31.7	28.6	25.5
Greatest height mandible	12.5	11.0		11.8	11.2	10.7	10.4	9.3	8.6	11.0	10.0	9.1
Coracoid												
External length**	42.5	41.8	41.4	47.9	45.9	44.6	42.0	41.7	41.1	43.2	40.4	39.4
Depth to procoracoid**	11.5	11.0	9.7	12.0	11.2	10.5	11.3	10.5	10.0	11.2	10.4	10.0
Breadth glenoid facet	6.5	5.6	3.5	6.4	5.6	5.2	5.7	5.3	4.8	5.6	5.1	4.7
Humerus												
Greatest length	90 approx.	89.9	85.7	99.3	93.4	86.3	88.5	87.6	87.0	91.8	87.6	83.3
Proximal breadth**	18.0	17.4	16.4	18.5	17.7	17.0	17.2	16.8	16.3	17.4	16.5	16.2
Ectepicondylar prominence**	12.3	11.1	11.0	12.3	11.6	11.0	11.5	11.2	11.0	11.3	10.9	10.0
Radius												
Length	66 approx.	65.3	64.0	72.2	68.9	65.8	65.2	62.7	61.8	66.4	63.6	61.0
Carpometacarpus												
External length	47.5	44.3	44.0	49.1	47.6	45.4	45.7	44.4	43.1	46.8	44.4	43.4
Length process metacarpal I	9.3	8.1	7.4	9.4	8.5	8.0	8.6	7.8	7.3	8.8	7.9	7.5

* Numbers in parentheses indicate number of specimens measured (for *U. l. lomvia*, only one skull available).
** See *Measurements* under Systematics for explanation of areas measured.

With respect to this character comparison with *U. brodkorbi* is best observed on the right coracoid of the holotype in which the close proximity of the lower end of the procoracoid to the median edge of the shaft is discernible on the latex mold. In the humerus of *Australca,* the area below the head is broader and the pectoral scar longer and relatively flatter than in *U. brodkorbi*; distally the apex of the ectepicondylar process is more prominent and forms a more acute angle with the shaft. Although the *Australca* carpometacarpus resembles that of *U. brodkorbi* in the long process of metacarpal I, the angle between the process and the external trochlear crest is less acute. *U. brodkorbi* resembles the Recent species of *Uria* in this character.

The humerus of *Miocepphus* is similar to that of *U. brodkorbi* in having a flange from the pectoral attachment narrowing the area below the head. The attachment itself, however, is flatter and less ovoid, and the external tuberosity is less prominent anconally. The line of the M. latissimus dorsi anterioris slopes slightly palmad, as in *U. brodkorbi,* but it is shorter. Distally, the tricipital grooves are equal in size as in *Alca,* as distinguished from the condition in *Uria.* The ectepicondylar process is even more prominent than in *Australca,* and terminates in a distinct papilla.

Summary and Conclusions

The holotype skeletal impression of *Uria brodkorbi,* transformed by latex molds into bones in relief, provides a rare opportunity to study the morphology of the associated elements of one individual fossil bird.

Viewed as a whole, the skeleton resembles that of the murres, genus *Uria.* In relation to Recent species of the genus it appears to have been of sturdier build, with a stronger sternum and a short beak. Although in length the coracoid and humerus are within the size range of *U. aalge californica* (see Table 1), the breadth of these elements equals or surpasses those of the larger *U. lomvia arra.* The carpometacarpus is similar to some specimens of *U. lomvia* in the rounding of the distal end of metacarpal III, and closely resembles *U. l. arra* in size.

Some of the individual elements, if found isolated, might well suggest generic distinction from Recent *Uria.* This is particularly true of the sternum and humerus. However, the large series of modern skeletons studied reveals trends toward one or more of the apparently distinctive characters. Although no single Recent skeleton of *Uria* has a combination of characters matching those of the fossil, there is sufficient similarity within the comparative series to indicate that *U. brodkorbi* is entirely consistent with what would be expected in a Miocene ancestor within the genus.

Therefore, the evidence weighs in favor of the new species being retained in the genus *Uria,* rather than in the erection of a new genus.

Acknowledgments

I am especially indebted to Pierce Brodkorb for the opportunity to study this important specimen from the Sisquoc Formation, and for providing the photograph taken by Robert D. Weigel (Fig. 2). I am also deeply grateful to my husband, Henry Anson Wylde, for preparing the latex molds of the specimen and

for photographing Figures 1, 3 and 4. Richard Meier (LACM) assisted by making the excellent print of the photograph for Figure 1.

My thanks are also extended to Storrs L. Olson, Stuart L. Warter, Jean Geary and Diana Matthiesen for providing comparative material. My continuing appreciation is extended to members of the two science divisions of the Natural History Museum of Los Angeles County for their cooperation.

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Reproduction of the Onespot Fringehead, *Neoclinus uninotatus*, in Monterey Harbor, California

David G. Lindquist

Abstract.—Reproduction of the onespot fringehead, *Neoclinus uninotatus* in Monterey Harbor, Monterey, California by David G. Lindquist, *Bull. Southern California Acad. Sci.*, 80(1):12–22, 1981. Males have greater development of the primary ocular cirrus. Nesting males were observed January to March and June to September. Males guarded large egg masses attached to the ceiling and sides